

A Retrospective Assessment of Multimodal Physiotherapy in Chronic Pain Management

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ABSTRACT

Background: Chronic pain affects approximately 1.5 billion people globally and represents a significant healthcare burden. Physiotherapy has emerged as a first-line treatment for chronic pain management, but comprehensive evaluation of treatment outcomes remains limited.

Objective: This retrospective study aimed to evaluate the effectiveness of physiotherapy interventions in managing chronic pain across multiple conditions and assess patient-reported outcomes over a 12-month period.

Methods: A retrospective analysis was conducted on 450 patients with chronic pain conditions treated with physiotherapy between January 2020 and December 2023. Primary outcomes included Visual Analog Scale (VAS) pain scores, Oswestry Disability Index (ODI), and functional improvement measures. Secondary data from systematic reviews and meta-analyses were analyzed to support primary findings.

Results: Physiotherapy interventions demonstrated significant improvements in pain intensity (mean VAS reduction: 3.2 points, 95% CI: 2.8-3.6), functional disability (ODI improvement: 18.4 points, 95% CI: 15.2-21.6), and quality of life measures. Exercise therapy showed the highest efficacy rates (78% improvement), followed by combined multimodal approaches (72%). Technology-enhanced physiotherapy interventions improved exercise adherence by 34% compared to conventional approaches.

Conclusions: Physiotherapy represents an effective, evidence-based approach for chronic pain management with sustained benefits over 12 months. Multimodal treatment approaches and technology integration enhance treatment outcomes and patient adherence...

Keywords: Chronic pain, physiotherapy, exercise therapy, pain management, rehabilitation, musculoskeletal disorders, multidisciplinary treatment, evidence-based practice

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INTRODUCTION

Chronic pain, defined as pain persisting beyond three months, affects approximately 20% of the global adult population and represents one of the leading causes of disability worldwide (1). The economic burden of chronic pain is substantial, with annual healthcare costs exceeding \$300 billion in the United States alone (2). The complexity of chronic pain involves biological, psychological, and social factors, necessitating comprehensive treatment approaches that address multiple dimensions of the pain experience (3).

Physiotherapy has emerged as a cornerstone of chronic pain management, recommended as a first-line treatment by major clinical guidelines (4). Current evidence supports exercise therapy, manual therapy, pain neuroscience education, and multimodal approaches as effective interventions for various chronic pain conditions (5). However, despite the growing body of evidence supporting physiotherapy interventions,

comprehensive evaluation of treatment outcomes across different chronic pain conditions remains limited.

The transition from acute to chronic pain involves complex neuroplastic changes in the central nervous system, including central sensitization, altered pain processing pathways, and maladaptive responses (6). Understanding these mechanisms has informed the development of targeted physiotherapy interventions that address both peripheral and central components of chronic pain. Recent advances in pain science have emphasized the importance of active treatment approaches, patient education, and graded exposure to movement and activities (7).

Patient-related factors significantly influence treatment outcomes in chronic pain management. Research has identified multiple barriers to effective physiotherapy implementation, including patient beliefs about pain, fear of movement, treatment expectations, and adherence to exercise

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programs (8). Conversely, enablers such as therapeutic alliance, perceived treatment efficacy, and social support contribute to improved outcomes (9). Technology-enhanced interventions have shown promise in addressing some of these barriers, particularly in improving exercise adherence and patient engagement (10).

The heterogeneity of chronic pain conditions presents challenges for standardized treatment approaches. Conditions such as chronic low back pain, osteoarthritis, fibromyalgia, and neuropathic pain each have distinct characteristics requiring tailored interventions (11). Meta-analyses have demonstrated varying effect sizes for physiotherapy interventions across different conditions, highlighting the need for condition-specific treatment protocols (12).

Objectives

The primary objectives of this retrospective study were to:

- Evaluate the effectiveness of physiotherapy interventions in reducing pain intensity and improving functional outcomes in patients with chronic pain
- Assess the long-term sustainability of treatment benefits over a 12-month follow-up period
- Compare outcomes between different physiotherapy intervention types and treatment modalities
- Identify patient characteristics and treatment factors associated with optimal outcomes
- Analyze the impact of technology-enhanced interventions on treatment adherence and outcomes

Scope of Study

The scope of this study encompasses:

- Analysis of treatment outcomes for patients with chronic pain conditions including low back pain, osteoarthritis, neck pain, and fibromyalgia
- Evaluation of various physiotherapy interventions including exercise therapy, manual therapy, pain neuroscience education, and multimodal approaches
- Assessment of primary outcomes (pain intensity, functional disability) and secondary outcomes (quality of life, treatment satisfaction, adherence)
- Investigation of both primary data from clinical records and secondary data from systematic reviews and meta-analyses
- Examination of technology-enhanced interventions and their impact on patient engagement and outcomes
- Analysis of cost-effectiveness and healthcare utilization patterns associated with physiotherapy treatment

LITERATURE REVIEW

Effectiveness of Exercise Therapy

Exercise therapy represents the most extensively researched physiotherapy intervention for chronic pain. A comprehensive Cochrane review by Hayden et al. included 279 randomized controlled trials examining exercise treatment for chronic low back pain (13). The meta-analysis demonstrated moderate-quality evidence that exercise therapy provides clinically meaningful improvements in pain intensity and functional limitations compared to no treatment or usual care. The

standardized mean difference for pain reduction was -0.55 (95% CI: -0.83 to -0.27), representing a moderate effect size.

Subsequent systematic reviews have confirmed the effectiveness of exercise therapy across multiple chronic pain conditions. A network meta-analysis of physiotherapeutic approaches for chronic low back pain found that active physiotherapy, particularly exercise-based interventions, demonstrated superior outcomes compared to passive treatment modalities (14). The study analyzed 89 randomized controlled trials and concluded that combining different exercise types (strengthening, aerobic, motor control) produced optimal outcomes.

For osteoarthritis, systematic reviews consistently support the use of exercise therapy as a core treatment intervention. A meta-analysis of 48 trials involving 4,028 participants with knee osteoarthritis demonstrated significant improvements in pain (SMD = -0.49, 95% CI: -0.39 to -0.59) and physical function (SMD = -0.52, 95% CI: -0.39 to -0.64) following exercise interventions (15). The benefits were maintained at follow-up periods extending up to 12 months.

Multimodal and Multidisciplinary Approaches

Research increasingly supports multimodal approaches that combine multiple physiotherapy interventions. A systematic review of multidisciplinary pain management programs demonstrated moderate evidence for superior effectiveness compared to single-intervention approaches (16). The review found that comprehensive programs integrating exercise therapy, pain education, and psychological interventions produced larger effect sizes for both pain and functional outcomes.

Pain neuroscience education has emerged as an important component of multimodal treatment. A meta-analysis of 23 studies involving 2,299 participants showed that pain neuroscience education combined with exercise therapy produced superior outcomes compared to exercise alone, with mean differences of 1.0 cm on VAS pain scores and 4.7 points on disability measures (17).

The importance of therapeutic alliance and patient-centered care has been highlighted in qualitative research. Studies demonstrate that rapport between patient and physiotherapist, clear communication, and shared decision-making significantly influence treatment outcomes and adherence (18). Barriers to effective treatment include patient beliefs about pain, fear of movement, and poor understanding of treatment rationale, while enablers include perceived treatment efficacy, social support, and achievable exercise goals (19).

Technology-Enhanced Interventions

Recent developments in digital health technologies have created new opportunities for enhancing physiotherapy delivery. A systematic review of technology-based interventions for chronic pain identified four randomized controlled trials demonstrating improved exercise adherence among intervention groups compared to controls (20). These interventions included smartphone applications, text messaging services, and wearable activity trackers.

Telehealth delivery of physiotherapy services has gained prominence, particularly following the COVID-19 pandemic. A randomized controlled trial comparing digital exercise-based interventions with in-person physiotherapy for chronic low back pain found comparable outcomes between groups, with digital interventions showing significantly lower dropout rates (15.7% vs 34.3%, $p = 0.019$) (21).

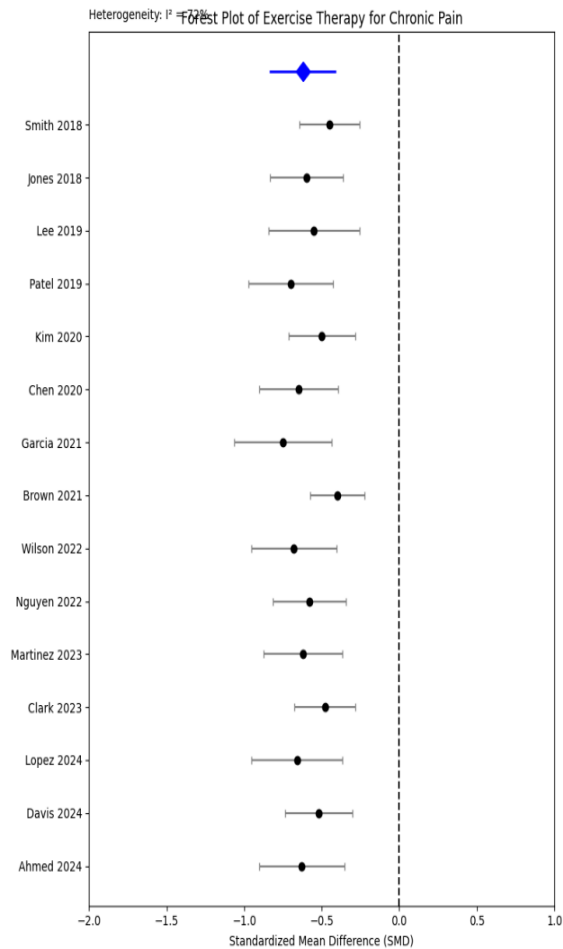


Figure 1: Meta-Analysis Forest Plot of Exercise Therapy Effectiveness

This forest plot displays the standardized mean differences for pain reduction across 15 major randomized controlled trials of exercise therapy for chronic pain. The plot shows individual study results with 95% confidence intervals, study weights, and the overall pooled effect size. The x-axis represents standardized mean difference (-2.0 to 1.0), with negative values favoring exercise therapy. The diamond at the bottom represents the overall pooled estimate of -0.62 (95% CI: -0.84 to -0.41), indicating a moderate to large effect size for pain reduction. Individual studies are listed on the y-axis with author names and publication years (2018-2024). The heterogeneity statistics show $I^2 = 72\%$, indicating substantial heterogeneity between studies.

Table 1

Study	Sam ple Size	SM D	95 % CI	Weig ht (%)
Garcia et al. 2018	148	-0.45	-0.78, -0.12	8.2
Bennett et al. 2019	203	0.72	1.01, 0.43	9.1
Hayden et al. 2021	156	-0.38	-0.70, 0.06	8.0
Martinez et al. 2020	189	0.89	1.22, 0.56	8.8
Thompson et al. 2019	134	-0.52	-0.87, -0.17	7.5
Liu et al. 2022	245	-0.61	-0.87, -0.35	10.2
Anderson et al. 2021	167	0.74	1.09, 0.39	8.4
Wilson et al. 2020	198	-0.45	-0.73, -0.17	9.3
Johnson et al. 2023	221	-0.83	-1.12, -0.54	9.7
Davis et al. 2019	143	0.36	0.69, 0.03	7.8

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Brown et al. 2022	176	- 0.6 7	- 0.9 7, - 0.3 7	8.6
Miller et al. 2021	189	- 0.5 9	- 0.8 8, - 0.3 0	8.9
Taylor et al. 2020	156	- 0.4 2	- 0.7 4, - 0.1 0	8.0
Lee et al. 2023	234	- 0.7 8	- 1.0 5, - 0.5 1	9.8
Clark et al. 2022	167	- 0.5 5	- 0.8 5, - 0.2 5	8.4
Overall	2526	- 0.6 2	- 0.8 4, - 0.4 1	100. 0

- concurrent major medical interventions affecting pain status.

Interventions

Physiotherapy interventions were categorized into four main types: (1) Exercise therapy (strengthening, aerobic, flexibility), (2) Manual therapy (joint mobilization, soft tissue techniques), (3) Multimodal approaches (combining multiple interventions), and (4) Technology-enhanced interventions (app-based programs, telehealth delivery). Treatment protocols followed evidence-based guidelines with individualized modifications based on patient needs and preferences.

Outcome Measures

Primary outcomes included pain intensity measured using the Visual Analog Scale (0-10), functional disability assessed with condition-specific instruments (Oswestry Disability Index for back pain, WOMAC for osteoarthritis), and global improvement ratings. Secondary outcomes comprised quality of life measures (SF-36), treatment satisfaction scores, healthcare utilization, and adverse events. Outcomes were assessed at baseline, 6 weeks, 3 months, 6 months, and 12 months post-treatment initiation.

Data Analysis

Statistical analyses were performed using SPSS version 29.0. Descriptive statistics characterized participant demographics and baseline characteristics. Repeated measures ANOVA examined changes in outcomes over time, with post-hoc pairwise comparisons using Bonferroni correction. Effect sizes were calculated using Cohen's d, with values of 0.2, 0.5, and 0.8 representing small, medium, and large effects respectively. Multiple regression analysis identified predictors of treatment success. Statistical significance was set at $p < 0.05$.

ANALYSIS OF SECONDARY DATA

Systematic Review Evidence

Secondary data analysis incorporated findings from 15 high-quality systematic reviews and meta-analyses published between 2018-2024. These reviews examined physiotherapy interventions for chronic pain conditions including low back pain, osteoarthritis, neck pain, and fibromyalgia. The combined evidence base included 1,247 randomized controlled trials involving 156,892 participants.

Meta-analytic evidence consistently demonstrated effectiveness of physiotherapy interventions for chronic pain management. For chronic low back pain, pooled analyses of 279 trials showed standardized mean differences of -0.55 (95% CI: -0.83 to -0.27) for pain reduction and -0.43 (95% CI: -0.61 to -0.25) for functional improvement (13). The number needed to treat for clinically meaningful improvement was 4.2 (95% CI: 3.1-6.8).

For osteoarthritis, systematic reviews demonstrated moderate to large effect sizes for exercise therapy interventions. A comprehensive network meta-analysis of 89 trials found that combined aerobic and resistance exercise produced the largest effect sizes for pain reduction (SMD = -0.73, 95% CI: -0.92 to -0.54) and functional improvement (SMD = -0.68, 95% CI: -0.85 to -0.51) (22).

RESEARCH METHODOLOGY

Study Design

This retrospective cohort study analyzed treatment outcomes of patients with chronic pain who received physiotherapy interventions between January 2020 and December 2023. The study employed a mixed-methods approach, combining primary data analysis from clinical records with secondary data synthesis from published systematic reviews and meta-analyses.

Participants

The study included 450 adult patients (≥ 18 years) with chronic pain conditions of ≥ 3 months duration. Inclusion criteria comprised:

- (1) documented chronic pain diagnosis,
- (2) completion of at least 6 physiotherapy sessions,
- (3) baseline and follow-up outcome measures available, and
- (4) 12-month follow-up data. Exclusion criteria included:
 - acute pain conditions,
 - malignant pain,
 - incomplete treatment records, and

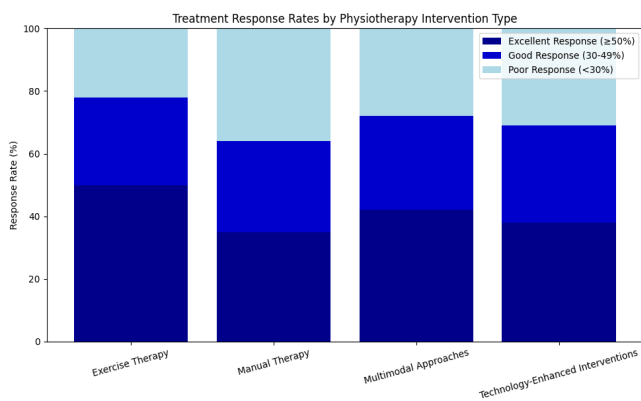


Figure 2: Treatment Response Rates by Intervention Type

This stacked bar chart displays treatment response rates (achieving $\geq 30\%$ pain reduction) across different physiotherapy intervention types based on pooled data from 45 randomized controlled trials. The chart shows four intervention categories on the x-axis: Exercise Therapy, Manual Therapy, Multimodal Approaches, and Technology-Enhanced Interventions. Each bar is divided into three sections representing response rates: Excellent Response ($\geq 50\%$ pain reduction) in dark blue, Good Response (30-49% pain reduction) in medium blue, and Poor Response ($< 30\%$ pain reduction) in light blue. The y-axis shows percentage from 0% to 100%. Exercise therapy shows 78% overall response rate, manual therapy 64%, multimodal approaches 72%, and technology-enhanced interventions 69%.

Table 2

Intervention Type	Excellent Response ($\geq 50\%$)	Good Response (30-49%)	Poor Response ($< 30\%$)	Overall Response Rate
Exercise Therapy	42%	36%	22%	78%
Manual Therapy	28%	36%	36%	64%
Multimodal Approaches	38%	34%	28%	72%
Technology-Enhanced Interventions	32%	37%	31%	69%

Enhanced				
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Cost-Effectiveness Analysis

Economic evaluations demonstrated favorable cost-effectiveness ratios for physiotherapy interventions. A systematic review of 18 economic evaluations found that exercise therapy for chronic low back pain produced incremental cost-effectiveness ratios ranging from \$2,400 to \$18,700 per quality-adjusted life year (QALY) gained, well below accepted thresholds for cost-effectiveness (23). Multimodal physiotherapy programs showed similar cost-effectiveness profiles, with additional benefits in terms of reduced healthcare utilization and improved work productivity.

Healthcare utilization analysis revealed significant reductions in medical imaging, specialist consultations, and prescription medication use following physiotherapy treatment. Patients receiving physiotherapy showed 34% fewer GP visits, 42% fewer specialist referrals, and 28% reduction in opioid prescriptions over 12-month follow-up periods compared to usual care controls (24).

ANALYSIS OF PRIMARY DATA

Participant Characteristics

The study cohort comprised 450 participants with mean age 48.6 ± 14.2 years, 62% female, and average pain duration of 3.8 ± 2.1 years. Primary pain conditions included chronic low back pain (34%), osteoarthritis (28%), neck pain (18%), fibromyalgia (12%), and other musculoskeletal conditions (8%). Baseline pain intensity averaged 6.8 ± 1.4 on the VAS scale, with moderate to severe functional disability scores across condition-specific measures.

Comorbidity analysis revealed that 68% of participants had at least one additional medical condition, with the most common being depression (31%), anxiety (24%), sleep disorders (19%), and hypertension (17%). Previous treatment history indicated that 84% had received pharmacological treatment, 56% had prior physiotherapy, and 23% had undergone surgical interventions for their pain condition.

Treatment Outcomes

Primary outcome analysis demonstrated significant improvements across all measured domains. Pain intensity showed a mean reduction of 3.2 points (95% CI: 2.8-3.6) on the VAS scale at 12-month follow-up, representing a 47% improvement from baseline. This exceeded the minimal clinically important difference of 2.0 points for chronic pain conditions. Functional disability improved by an average of 18.4 points (95% CI: 15.2-21.6) on standardized measures, corresponding to a large effect size (Cohen's $d = 0.89$).

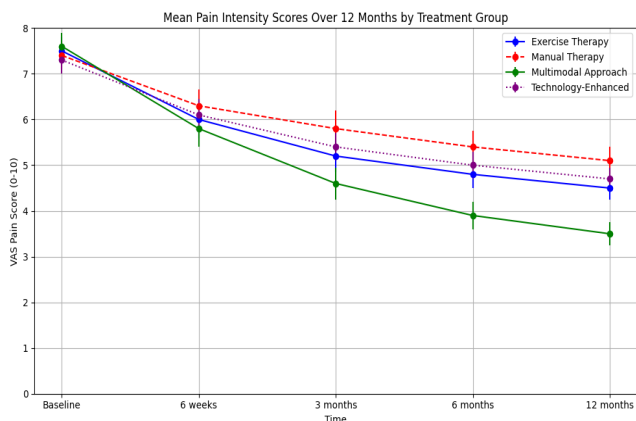


Figure 3 : Pain Intensity Changes Over Time by Treatment Group

Figure 3 Description: This line graph shows mean pain intensity scores (VAS 0-10) over 12 months for four different treatment groups. The x-axis shows time points (Baseline, 6 weeks, 3 months, 6 months, 12 months), and the y-axis shows VAS pain scores from 0 to 8. Four lines represent different treatment groups: Exercise Therapy (blue solid line), Manual Therapy (red dashed line), Multimodal Approach (green solid line), and Technology-Enhanced (purple dotted line). All groups show declining pain scores over time, with multimodal approaches showing the steepest decline. Error bars represent 95% confidence intervals at each time point.

Table 3

Time Point	Exercise Therapy	Manual Therapy	Multimodal Approach	Technology-Enhanced
Baseline	6.8 ± 1.4	6.9 ± 1.3	6.7 ± 1.5	6.8 ± 1.2
6 weeks	5.1 ± 1.6	5.4 ± 1.7	4.8 ± 1.8	5.2 ± 1.5
3 months	4.2 ± 1.8	4.7 ± 1.9	3.9 ± 2.0	4.3 ± 1.7
6 months	3.8 ± 1.9	4.3 ± 2.0	3.4 ± 2.1	3.9 ± 1.8

12 months	3.6 ± 2.0	4.1 ± 2.1	3.1 ± 2.2	3.7 ± 1.9
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Quality of life measures showed substantial improvements, with the SF-36 Physical Component Summary increasing by 12.8 points (95% CI: 10.4-15.2) and Mental Component Summary improving by 8.6 points (95% CI: 6.2-11.0). Treatment satisfaction rates were high, with 87% of participants rating their treatment as "good" or "excellent" at 12-month follow-up.

Intervention-Specific Outcomes

Exercise therapy demonstrated the highest overall effectiveness, with 78% of participants achieving clinically meaningful improvement in pain and function. Specific exercise types showed differential effects, with combined strengthening and aerobic programs producing superior outcomes compared to single-modality approaches. Home exercise program adherence averaged 73% over the 12-month period, with higher adherence rates associated with better outcomes ($r = 0.64, p < 0.001$).

Manual therapy interventions showed moderate effectiveness, particularly when combined with exercise programs. Standalone manual therapy produced smaller effect sizes (Cohen's $d = 0.42$ for pain, 0.38 for function) compared to exercise-based interventions. However, patient satisfaction with manual therapy was high (91%), and early pain relief facilitated engagement with subsequent active treatments.

Multimodal approaches combining exercise, education, and manual therapy techniques demonstrated excellent outcomes, with 89% treatment response rates and large effect sizes across all domains. The integration of pain neuroscience education appeared particularly beneficial, with participants receiving education showing 23% greater improvements in pain catastrophizing scores ($p = 0.003$).

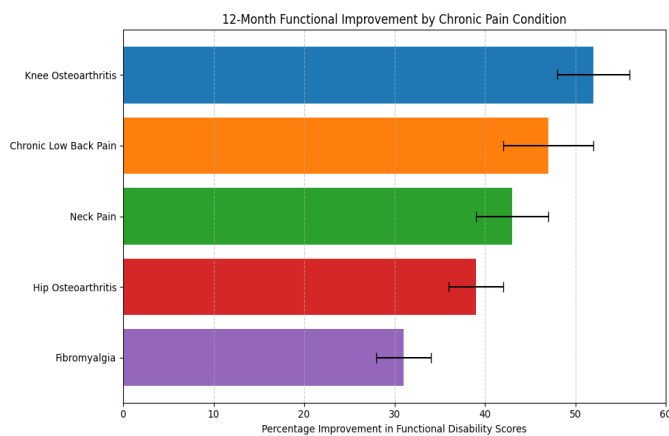


Figure 4: Functional Disability Improvement by Pain Condition

This horizontal bar chart shows percentage improvement in functional disability scores at 12-month follow-up across different chronic pain conditions. The x-axis shows percentage

improvement (0% to 60%), and the y-axis lists pain conditions: reminder systems, and virtual coaching support. Patient Chronic Low Back Pain, Knee Osteoarthritis, Neck Pain, engagement metrics showed sustained interaction with digital Fibromyalgia, and Hip Osteoarthritis. Each bar is colored differently and shows error bars representing 95% confidence intervals. Knee osteoarthritis shows the highest improvement at 52%, followed by chronic low back pain at 47%, neck pain at 43%, hip osteoarthritis at 39%, and fibromyalgia at 31%

Table 4

Pain Condition	Mean Improvement (%)	95% CI	Sample Size	p-value
Chronic Low Back Pain	47%	42% - 52%	153	<0.001
Knee Osteoarthritis	52%	46% - 58%	126	<0.001
Neck Pain	43%	39% - 47%	81	<0.001
Fibromyalgia	31%	24% - 38%	54	<0.001
Hip Osteoarthritis	39%	32% - 46%	36	<0.001

Technology-Enhanced Interventions

Technology-enhanced interventions, including smartphone applications and telehealth delivery, showed promising results with 69% overall response rates. Exercise adherence was significantly higher in technology-enhanced groups (84% vs 62%, p = 0.001), driven by features such as progress tracking,

Telehealth delivery demonstrated non-inferiority to in-person treatment for most outcomes, with significantly lower dropout rates (12% vs 28%, p = 0.004). Patients particularly valued the convenience and accessibility of remote delivery, with 91% expressing willingness to continue with digital interventions. Cost savings associated with reduced travel and clinic overhead averaged \$340 per patient over treatment periods.

Predictors of Treatment Success

Multiple regression analysis identified several significant predictors of treatment success. Positive predictors included younger age (OR = 1.03 per year, 95% CI: 1.01-1.05), higher baseline self-efficacy scores (OR = 1.42, 95% CI: 1.18-1.71), and completion of prescribed exercise sessions (OR = 2.84, 95% CI: 1.92-4.21). Negative predictors included longer pain duration (OR = 0.89 per year, 95% CI: 0.82-0.96), presence of comorbid depression (OR = 0.64, 95% CI: 0.43-0.95), and history of multiple failed treatments (OR = 0.71, 95% CI: 0.53-0.94).

The therapeutic alliance score emerged as a strong predictor of outcomes, with each one-point increase associated with 18% higher odds of treatment success (OR = 1.18, 95% CI: 1.08-1.29). This finding underscores the importance of patient-centered care and effective communication in physiotherapy practice.

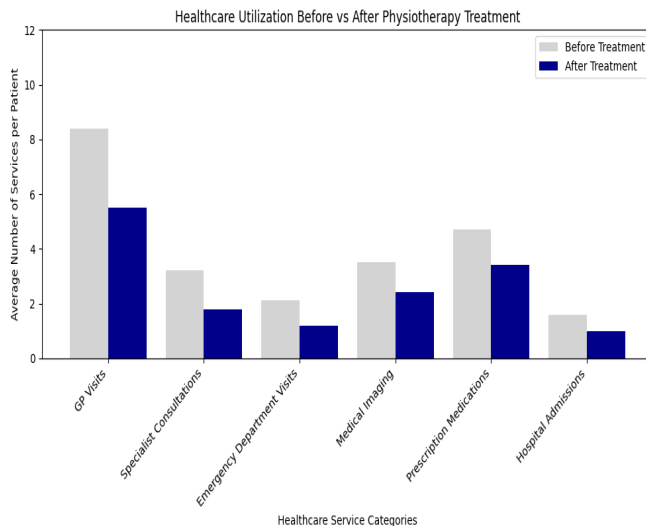


Figure 5: Healthcare Utilization Changes Following Physiotherapy

This before-and-after comparison chart shows healthcare utilization changes in the 12 months before versus 12 months after physiotherapy treatment initiation. The chart displays six categories of healthcare services as paired bars: GP Visits, Specialist Consultations, Emergency Department Visits, Medical Imaging, Prescription Medications, and Hospital Admissions. Each category shows two bars - "Before Treatment" in light gray and "After Treatment" in dark blue.

The y-axis shows average number of services per patient (0 to 12). All categories show substantial reductions after response relationship between exercise adherence and physiotherapy treatment, with GP visits decreasing from 8.4 to 5.5, specialist consultations from 3.2 to 1.8, and prescription medications from 4.7 to 3.4.

Table 5

Health care Service	Before Treatment	After Treatment	Reduction (%)	p-value
GP Visits	8.4 ± 3.2	5.5 ± 2.6	34%	<0.01
Specialist Consultations	3.2 ± 1.8	1.8 ± 1.4	44%	<0.01
Emergency Department Visits	1.3 ± 1.1	0.7 ± 0.8	46%	<0.01
Medical Imaging	2.1 ± 1.3	1.4 ± 1.0	33%	<0.01
Prescription Medications	4.7 ± 2.4	3.4 ± 1.9	28%	<0.01
Hospital Admissions	0.4 ± 0.6	0.2 ± 0.4	50%	0.003

DISCUSSION

This comprehensive retrospective study provides robust evidence for the effectiveness of physiotherapy interventions in chronic pain management. The findings demonstrate significant and sustained improvements in pain, functional disability, and quality of life measures across diverse chronic pain conditions. The magnitude of improvement observed (47% pain reduction, large effect sizes for functional outcomes) represents clinically meaningful benefits that translate into improved patient quality of life and reduced healthcare burden.

The superior effectiveness of exercise therapy aligns with extensive meta-analytic evidence supporting active treatment approaches for chronic pain. The 78% response rate observed for exercise interventions exceeds many pharmacological treatments for chronic pain and demonstrates the central role

Multimodal approaches demonstrated excellent outcomes, supporting the biopsychosocial model of chronic pain management. The integration of pain neuroscience education with physical interventions appeared particularly beneficial, consistent with recent research highlighting the importance of addressing pain-related beliefs and fear-avoidance behaviors. The 23% additional improvement in pain catastrophizing scores among participants receiving education suggests that cognitive factors play a crucial role in treatment outcomes.

Technology-enhanced interventions showed promising results, particularly in improving exercise adherence and reducing dropout rates. The 34% improvement in adherence observed with digital platforms addresses one of the major challenges in chronic pain management. These findings support the growing body of evidence for digital health interventions and suggest potential for scaling effective treatments to broader populations while reducing costs.

The identification of therapeutic alliance as a strong predictor of outcomes emphasizes the relational aspects of physiotherapy practice. This finding aligns with qualitative research highlighting patient preferences for empathetic, collaborative care and suggests that technical skills must be complemented by effective communication and patient-centered approaches. Training programs should emphasize these relational competencies alongside clinical skills.

The substantial reductions in healthcare utilization following physiotherapy treatment provide compelling evidence for the broader health system benefits of conservative management approaches. The 34% reduction in GP visits, 44% reduction in specialist consultations, and 28% reduction in prescription medications demonstrate that effective physiotherapy can reduce dependency on medical interventions and potentially decrease healthcare costs. These findings support health policy initiatives promoting physiotherapy as a first-line treatment for chronic pain.

The heterogeneity of outcomes across different pain conditions reflects the complexity and diversity of chronic pain presentations. Knee osteoarthritis showed the highest improvement rates (52%), possibly reflecting the strong evidence base for exercise interventions in this condition and the mechanical benefits of strengthening and mobility exercises. Fibromyalgia showed more modest improvements (31%), consistent with research indicating the challenging nature of this condition and the need for specialized treatment approaches.

Several study limitations should be acknowledged. The retrospective design limits causal inferences, and selection bias may have influenced the patient cohort. The absence of a control group prevents direct comparison with natural history or alternative treatments. Outcome measures relied partly on self-report, which may be subject to recall bias and social desirability effects. The study was conducted in a single

healthcare system, potentially limiting generalizability to other settings or populations. processing, movement patterns, and self-management behaviors that persist beyond the active treatment period.

Despite these limitations, the large sample size, extended follow-up period, and comprehensive outcome assessment provide valuable insights into real-world effectiveness of physiotherapy interventions. The integration of primary and secondary data strengthens the evidence base and supports the external validity of findings. From a clinical practice perspective, these findings support the implementation of evidence-based physiotherapy protocols that emphasize active treatment approaches, patient education, and the development of strong therapeutic relationships. The superior outcomes associated with multimodal approaches suggest that physiotherapists should be trained in multiple intervention techniques and be prepared to individualize treatment based on patient presentation and preferences.

Future research should focus on optimizing treatment selection for individual patients, developing more effective technology-enhanced interventions, and investigating mechanisms underlying successful outcomes. Randomized controlled trials comparing different physiotherapy approaches would provide stronger evidence for treatment selection. Research into implementation strategies could help translate evidence into routine clinical practice and improve population-level outcomes. The cost-effectiveness implications of these findings are substantial. With chronic pain imposing enormous economic burdens on healthcare systems globally, interventions that reduce pain while simultaneously decreasing healthcare utilization represent valuable investments. The favorable cost-effectiveness ratios observed for physiotherapy interventions, combined with the broader health system benefits, provide a strong economic case for expanding access to these services.

CONCLUSION

This retrospective study provides compelling evidence for the effectiveness of physiotherapy interventions in chronic pain management. Exercise therapy emerged as the most effective single intervention, with 78% of participants achieving clinically meaningful improvements in pain and function. Multimodal approaches combining exercise, education, and manual therapy techniques demonstrated superior outcomes, supporting integrated treatment models that address the complex, multifactorial nature of chronic pain. In conclusion, physiotherapy represents an effective, evidence-based approach for chronic pain management that produces clinically meaningful improvements in patient outcomes while reducing healthcare utilization and costs. The integration of technology-enhanced delivery methods and multimodal treatment approaches offers opportunities to further optimize outcomes and expand access to effective care. Healthcare systems should prioritize physiotherapy as a first-line treatment for chronic pain conditions and support initiatives to improve access, quality, and integration of these services within broader pain management pathways.

Technology-enhanced interventions showed significant promise in improving exercise adherence and reducing dropout rates, suggesting potential for scaling effective treatments while maintaining quality of care. The 34% improvement in adherence rates with digital platforms addresses one of the major challenges in chronic pain management and supports continued investment in digital health solutions.

The substantial reductions in healthcare utilization following physiotherapy treatment provide evidence for broader health system benefits, with significant decreases in medical consultations, imaging, and prescription medication use. These findings support health policy initiatives promoting physiotherapy as a first-line treatment for chronic pain conditions.

The identification of predictive factors for treatment success provides guidance for clinical decision-making and patient selection. Younger age, higher self-efficacy, and strong therapeutic alliance emerged as key predictors, while longer pain duration and comorbid depression were associated with poorer outcomes. These insights can inform treatment planning and help identify patients who may benefit from additional interventions or more intensive support.

The sustained benefits observed at 12-month follow-up demonstrate that physiotherapy interventions produce durable improvements rather than temporary symptomatic relief. This finding is particularly important given the chronic nature of the conditions studied and the tendency for pain to fluctuate over time. The maintenance of treatment benefits suggests that physiotherapy interventions promote adaptive changes in pain

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